Improved Techniques for Training Score-Based Generative Models

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Abstract

Score-based generative models can produce high quality image samples comparable to GANs, without requiring adversarial optimization. However, existing training procedures are limited to images of low resolution (typically below 32x32), and can be unstable under some settings. We provide a new theoretical analysis of learning and sampling from score models in high dimensional spaces, explaining existing failure modes and motivating new solutions that generalize across datasets. To enhance stability, we also propose to maintain an exponential moving average of model weights. With these improvements, we can effortlessly scale score-based generative models to images with unprecedented resolutions ranging from 64x64 to 256x256. Our score-based models can generate high-fidelity samples that rival best-in-class GANs on various image datasets, including CelebA, FFHQ, and multiple LSUN categories.